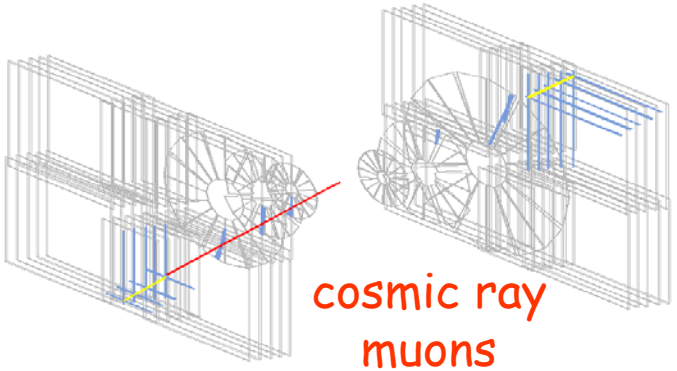
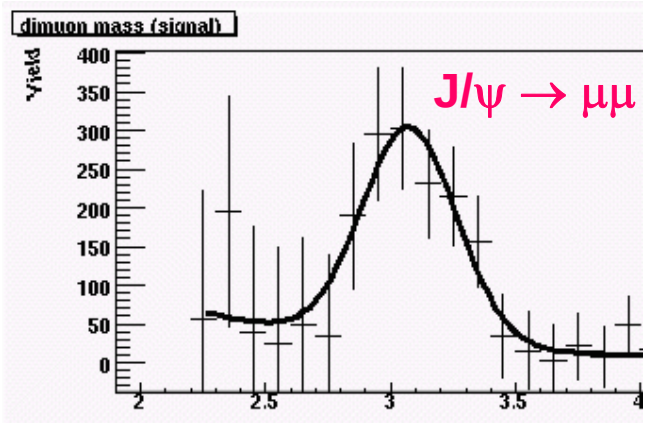
PHENIX Run7 Update

Mike Leitch, LANL
PHENIX Run Coordinator

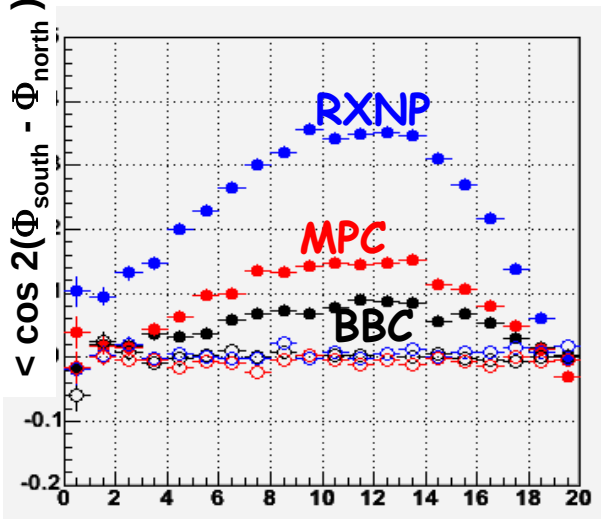
RHIC/AGS Users Meeting
21 June, 2007



cosmic ray muons

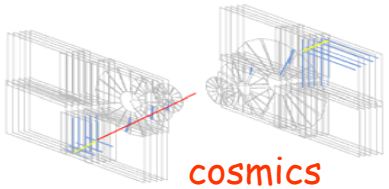


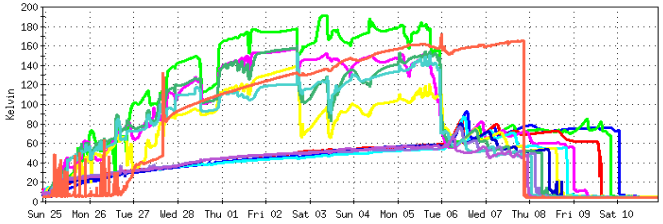
reaction plane

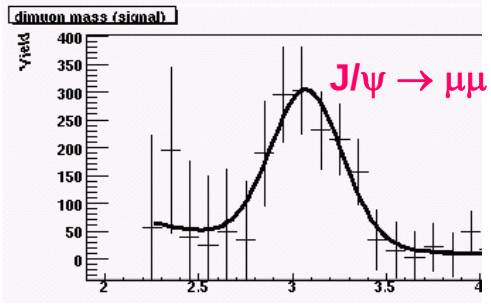


Run7 Chronology

- Originally hoped to start with Nov 1st cool-down and PHENIX planned for:
  - AuAu – 15 wks (1.1 nb-1), pp – 10 wks (32 pb-1)
- Delayed by continuing resolution & meager FY06 level to match
- But PHENIX started anyhow:
  - Cosmic rays starting Jan 9th
  - "Run7 is on" Feb 1st
  - Start of cool-down Feb 8th
  - Cryo problems Feb 24th
  - Rings cold & with beam Mar 13th
  - Start of Physics Mar 27th
- End of Run7 Jun 26th
- 13 wks of physics (Mar 27th - Jun 26th)

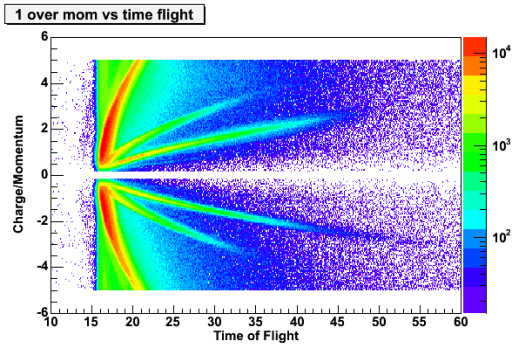


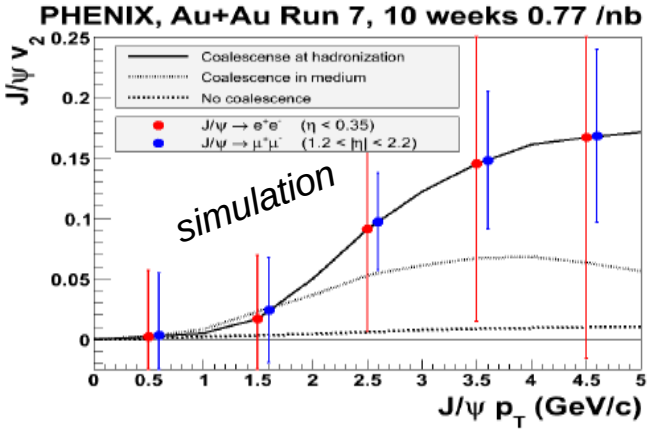


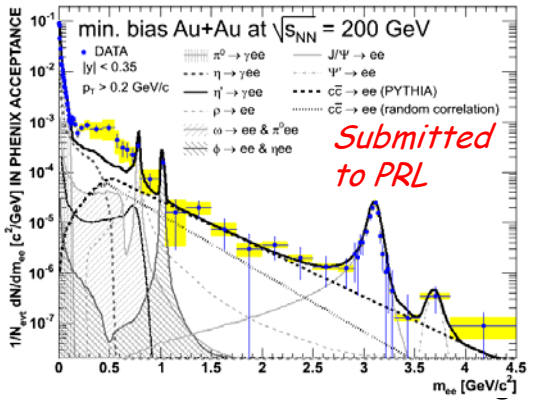


PHENIX Physics Goals for Run7

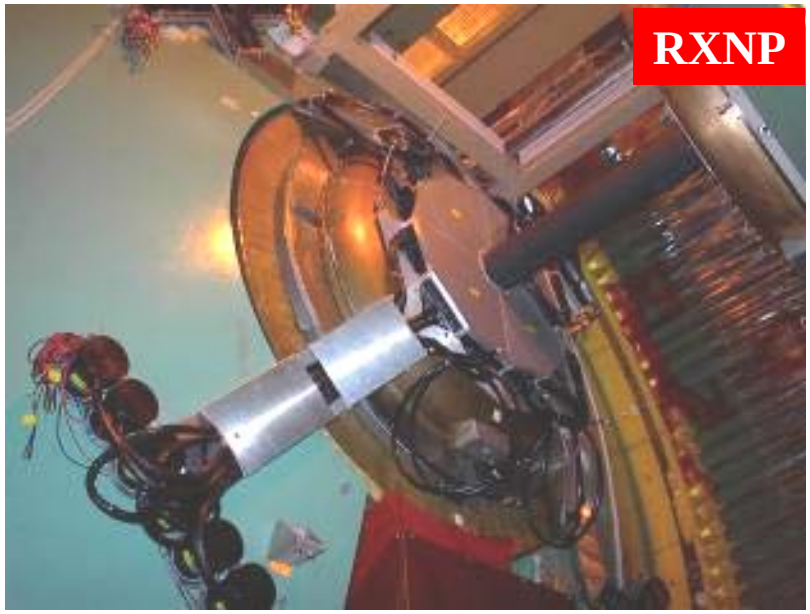
- Increase statistical & systematic precision of rare signals in AuAu, e.g. J/ψ, jet correlations, etc
- Increase reach in p_T, especially with PID from new TOF-West detector (p_T > 8 GeV/c)
  - Identified particle spectra
  - Identified leading particles in jets
- Factor of two or more improvement in Reaction Plane resolution - valuable to many signals
  - v_2 for J/ψ, γ - new
  - electrons, hadrons – extended
- Low-mass lepton pairs with the HBD

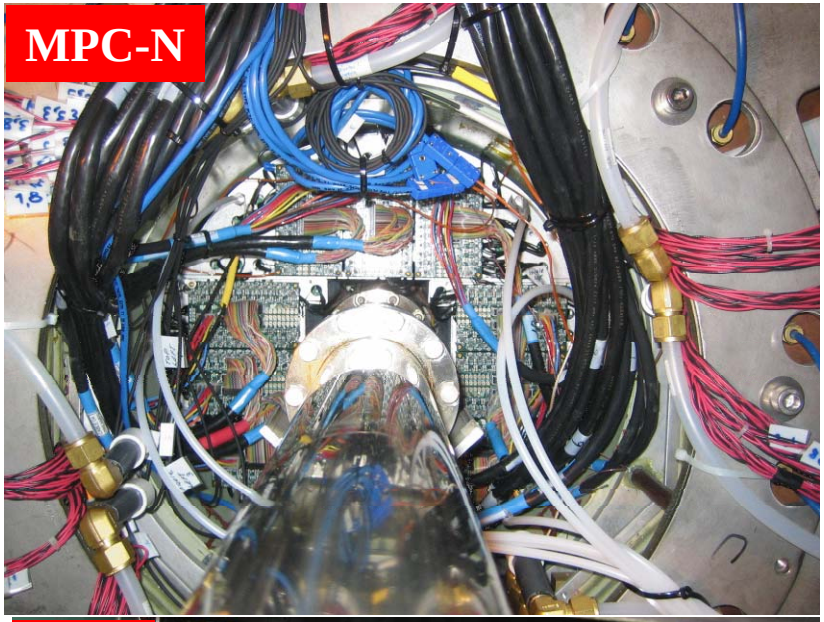


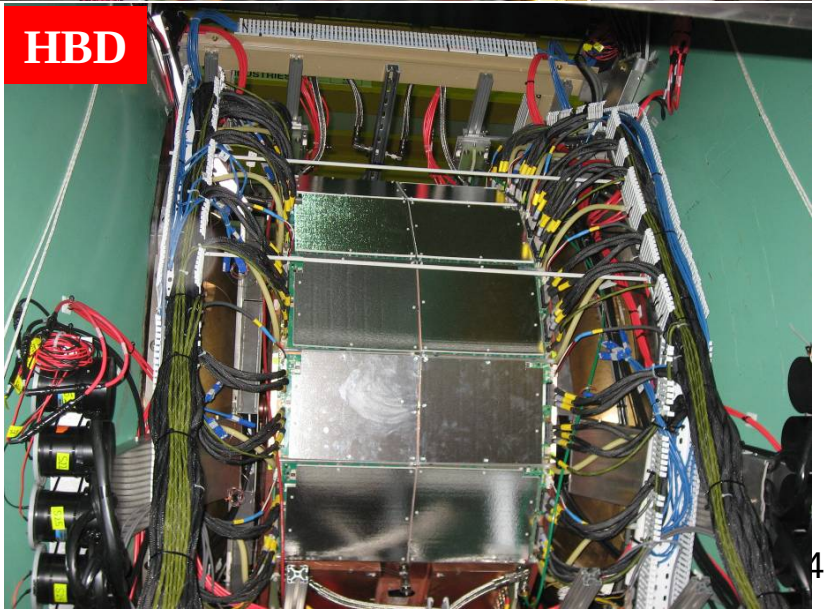




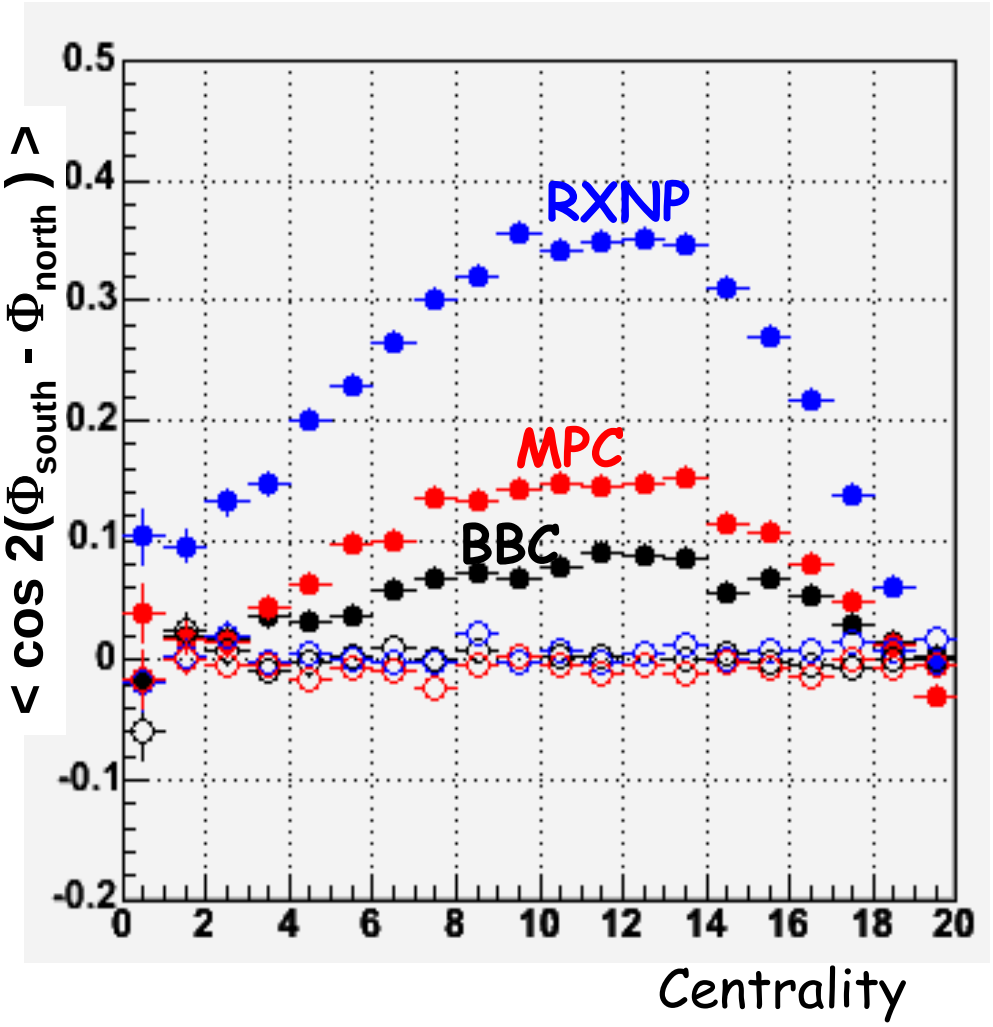
Four New Detector Subsystems for Run7

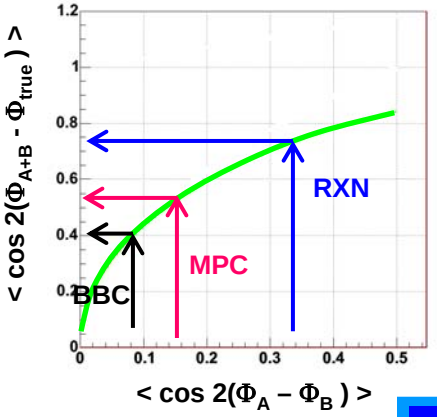






PHENIX Reaction Plane Measurements Now from MPC, RXNP & BBC

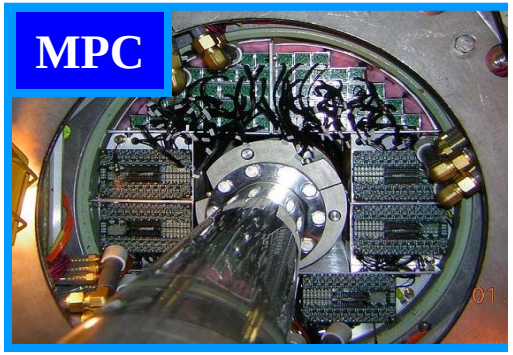




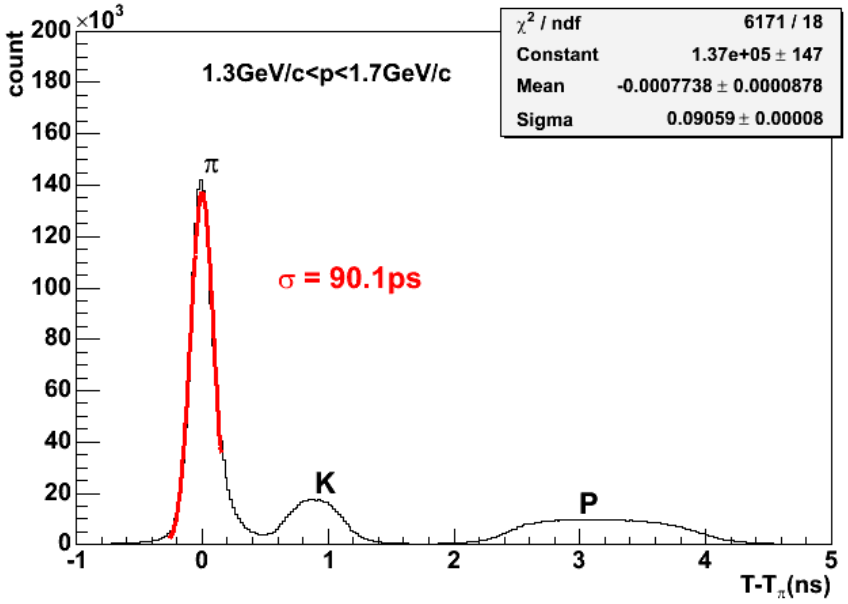
Reaction Plane Detector

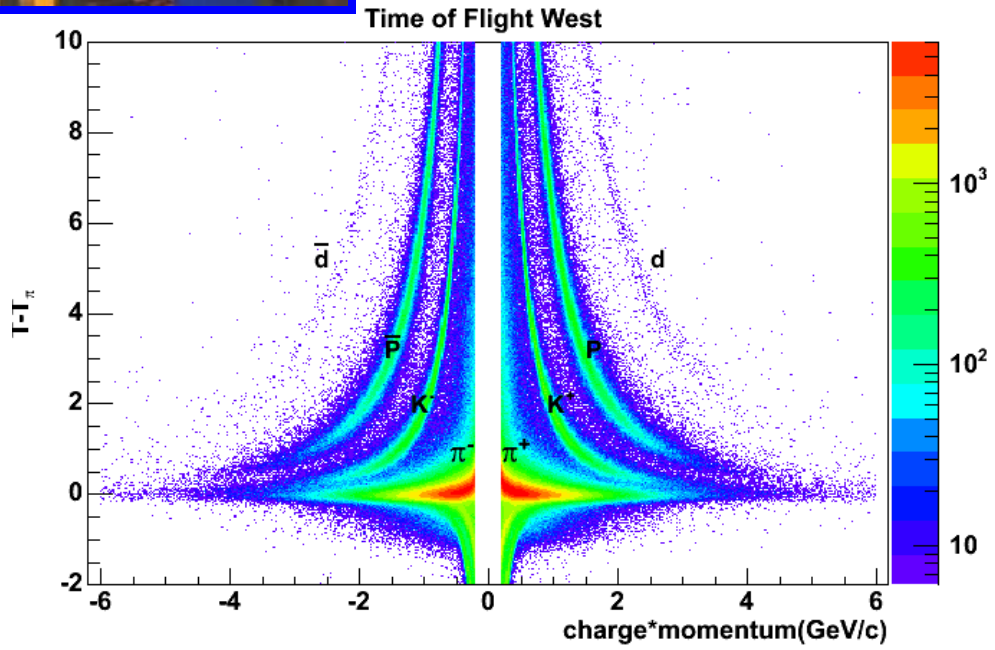
$$\delta\left(v_2^{\text{true}}\right) = \frac{\delta\left(v_2^{\text{expt}}\right)}{\sigma_{RP}}$$

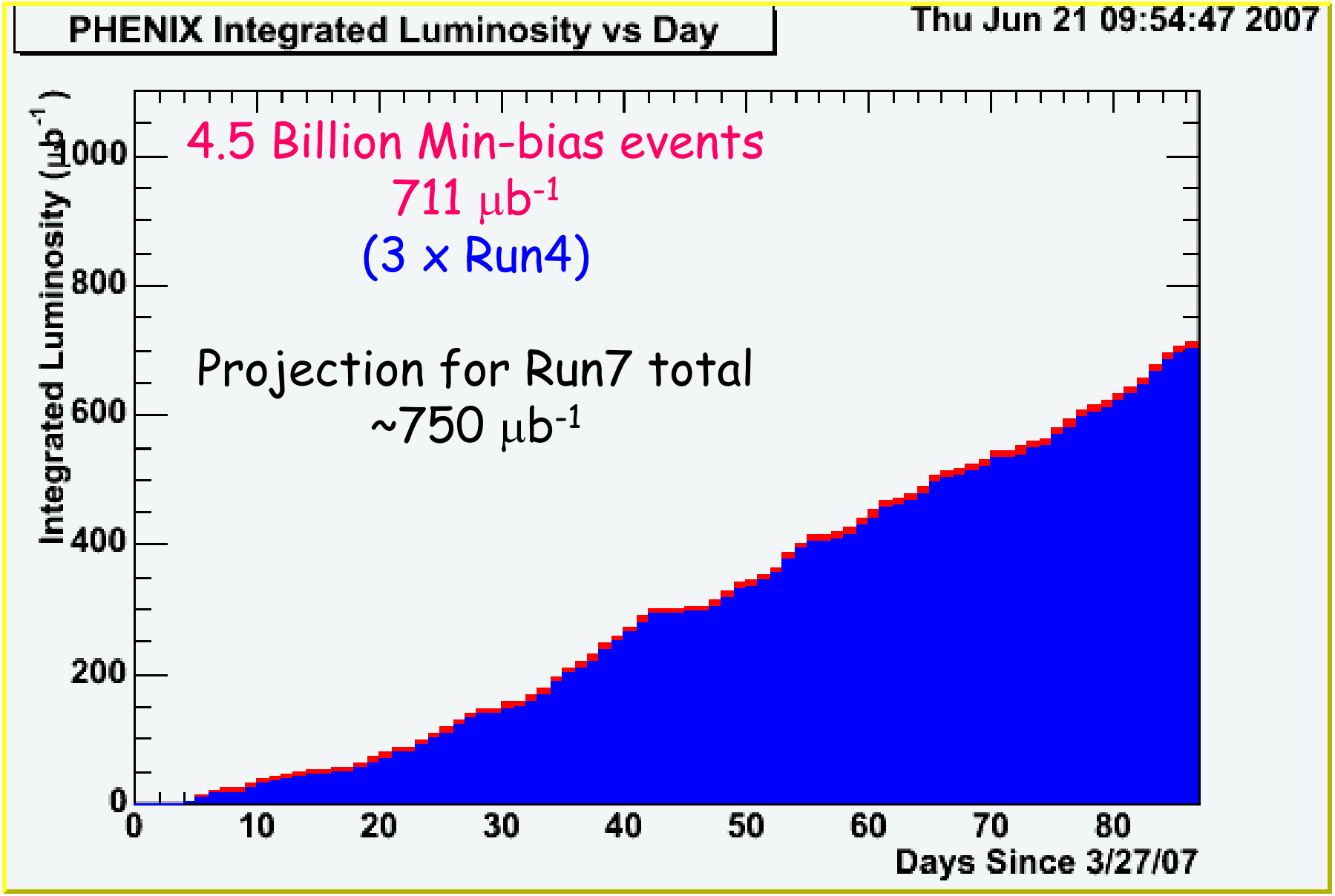
MPC



TOF-West Particle Identification

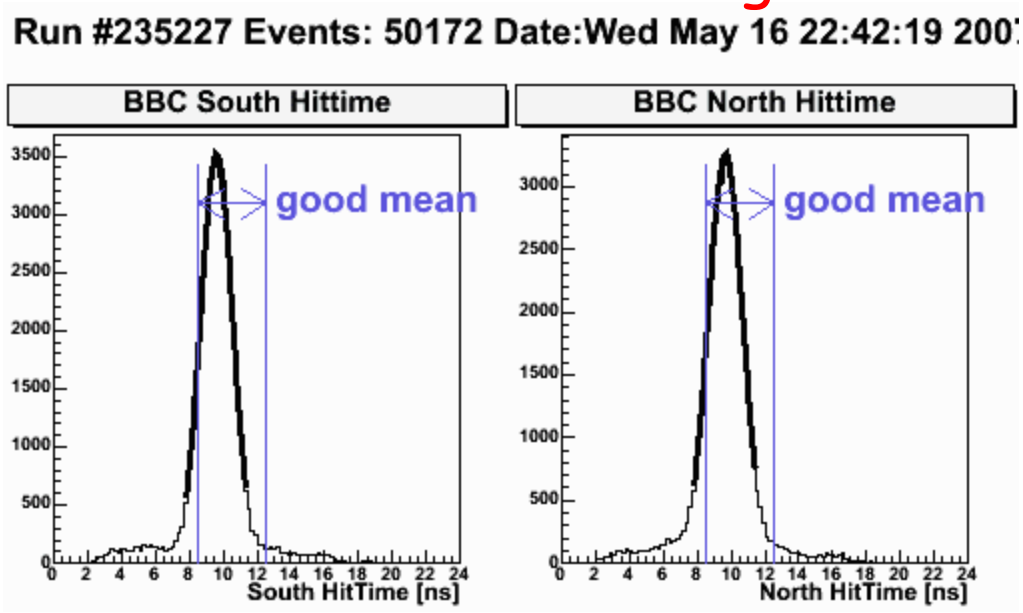




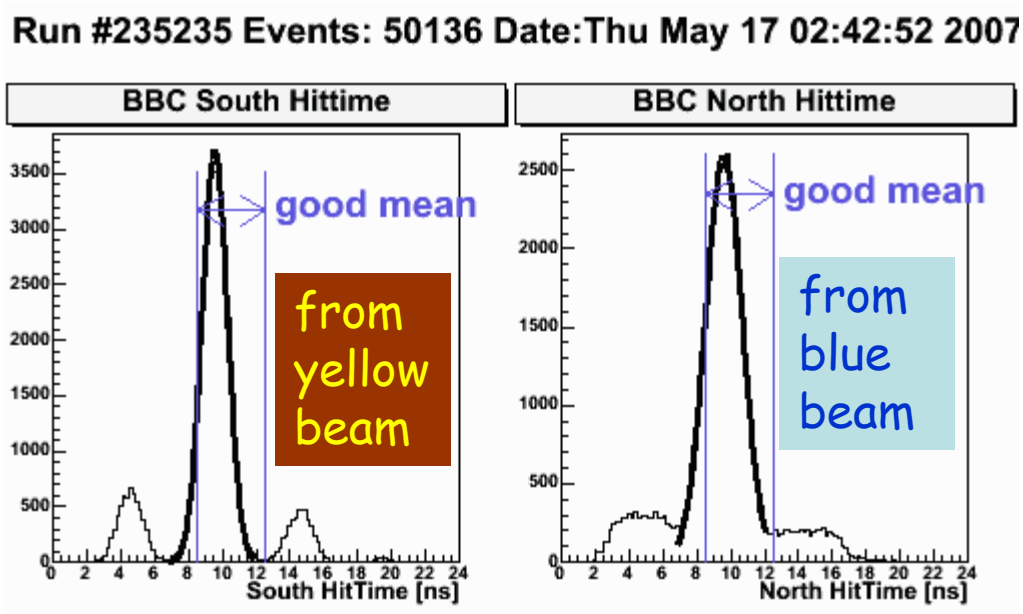

PHENIX Integrated Luminosity vs Day
Thu Jun 21 09:54:47 2007
4.5 Billion Min-bias events
711 μb-1
(3 x Run4)
Projection for Run7 total
~750 μb-1
Integrated Luminosity (μb-1)
0
200
400
600
800
1000
0
10
20
30
40
50
60
70
80
Days Since 3/27/07

Effects of Stochastic Cooling at PHENIX

beginning of store

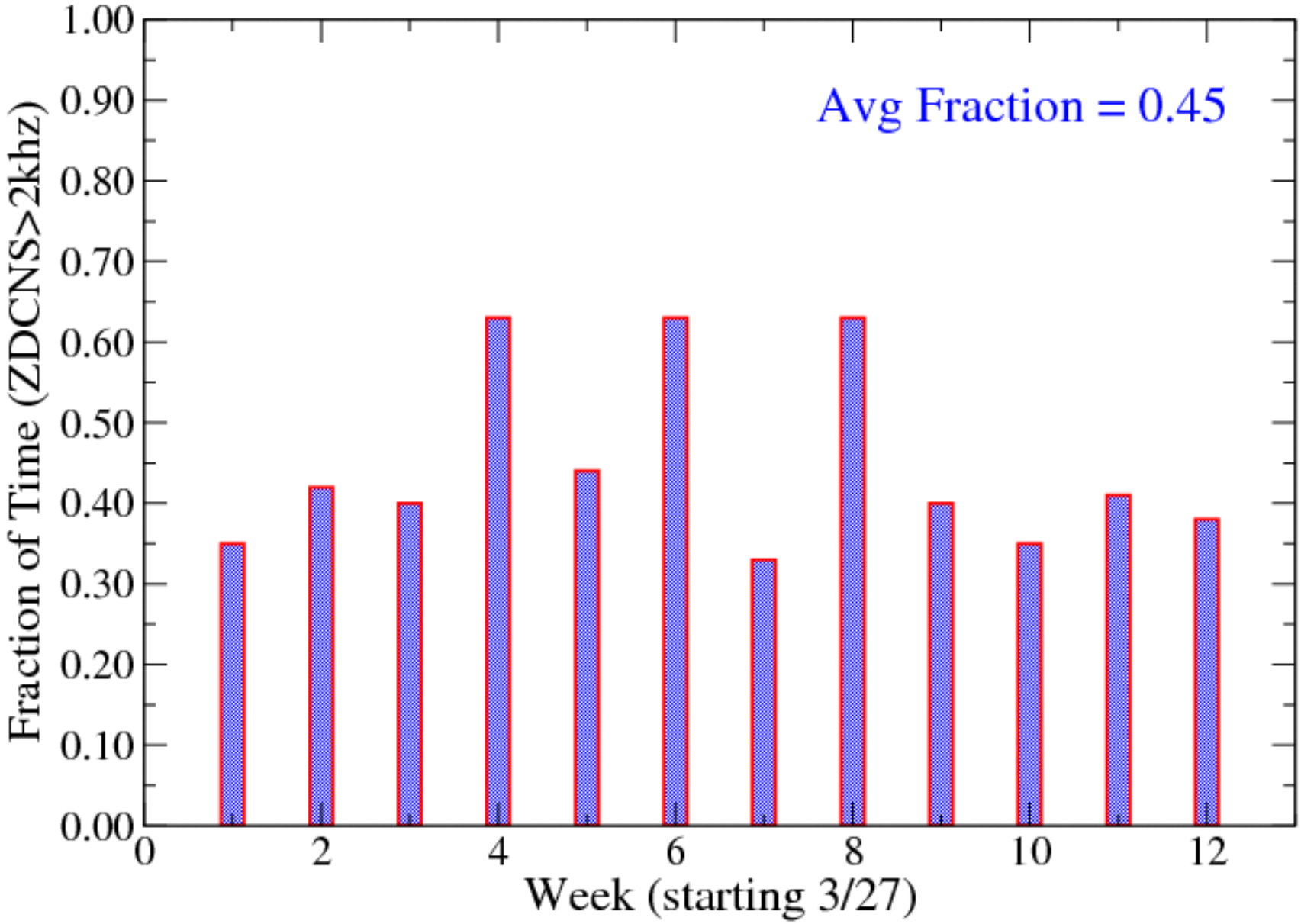


end of store

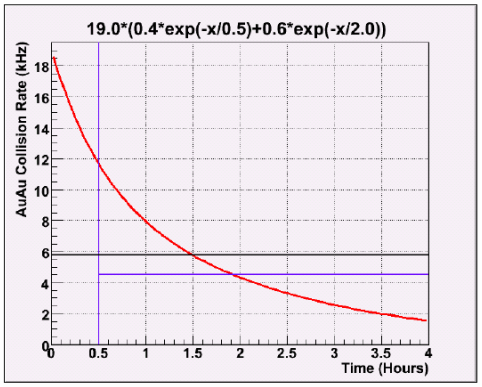


Improvement in integrated luminosity for PHENIX with Stochastic Cooling (SC)

16%


Avg Fraction = 0.45
Fraction of Time (ZDCNS>2khz)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
Week (starting 3/27)

PHENIX Triggering & fast analysis for Run7



Level-1 Triggering just Minimum-Bias (+UPC)

- 5 kHz event rate through DAQ
- only small fraction of integrated luminosity missed due to rates above the DAQ limit in the 1st ½ hour or so of stores

Level-2 filtering in ATP's producing selected, parallel sample of enriched events for fast processing

- $J/\psi \rightarrow \mu\mu$; $J/\psi \rightarrow ee$; high-p_T level-2 triggers
  - 10% of raw data size
  - sent to CCF in France via GRIDFTP
  - analyzed in France for fast results

10% of min-bias events sent to Vanderbilt for fast analysis of min-bias

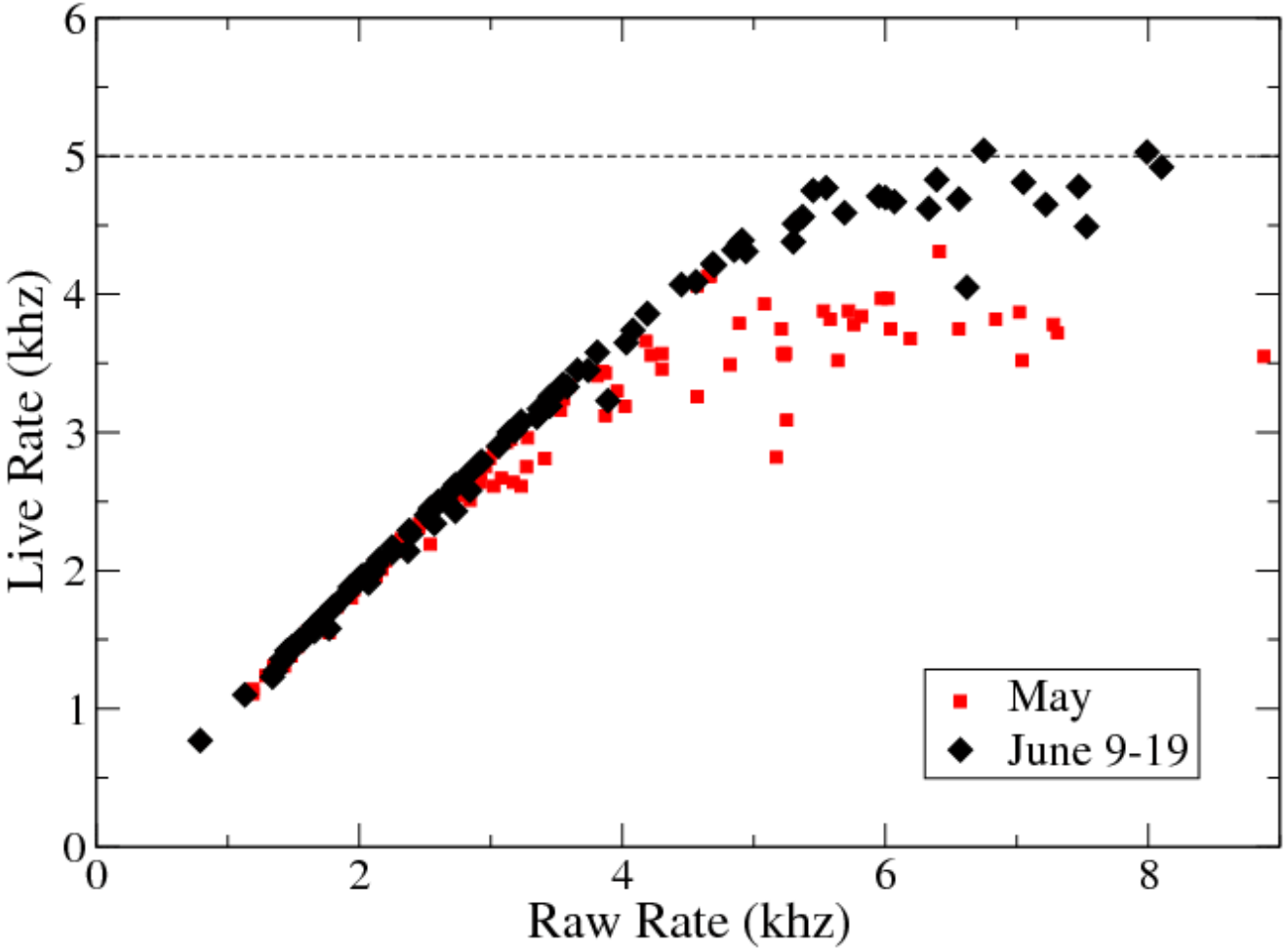
  - for physics not provided by level-2 triggers
  - & min-bias events needed for mixing, etc to support level-2 analysis

Counting house machines for fast HBD analysis

PHENIX Data Acquisition (DAQ)

Present DAQ performance:

• up to 5 khz event rate & 700 Mb/sec throughput



DAQ Advances:

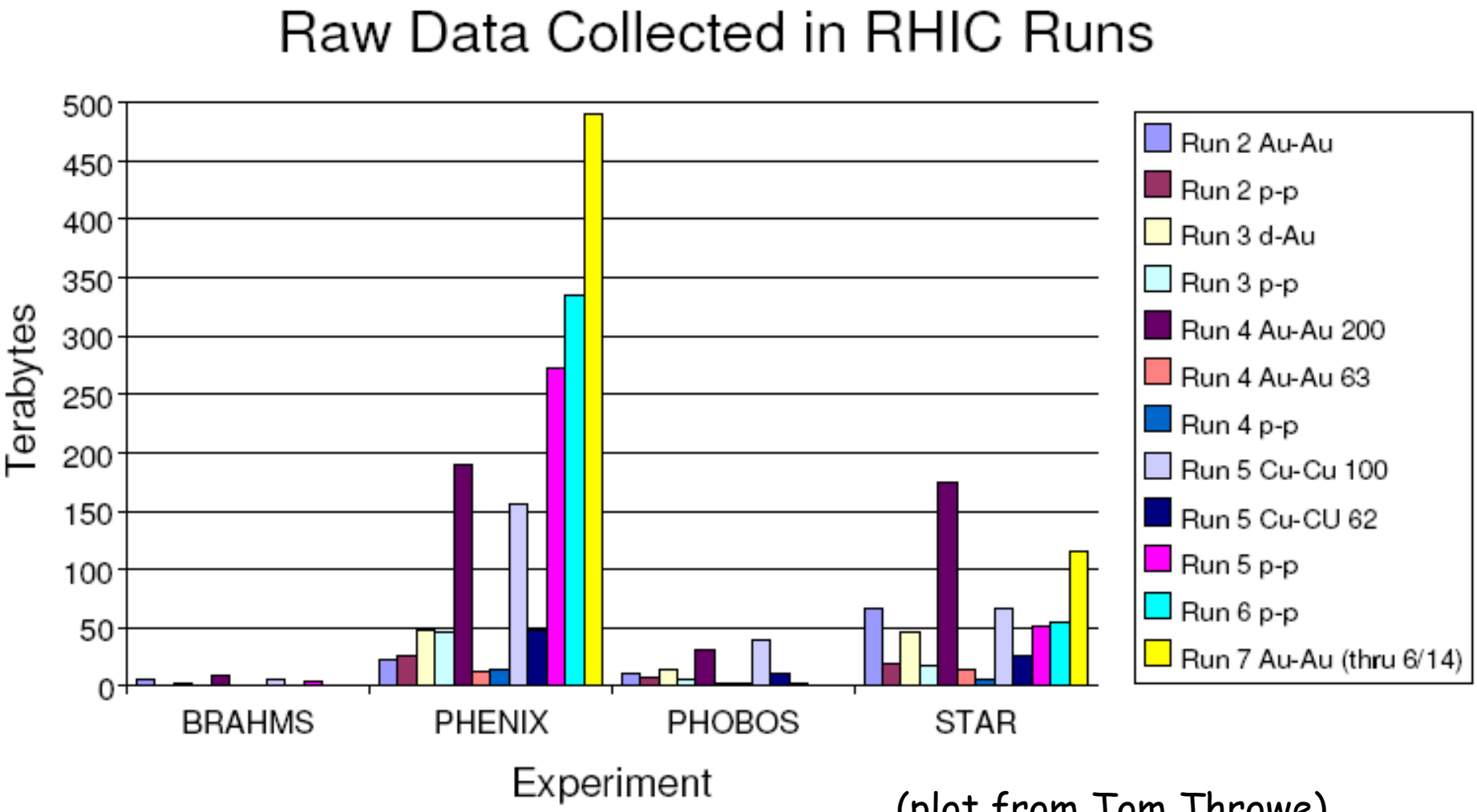
• level-2 code speedup

• additional buffer box

• fix SEB memory leaks

• more compact HBD data format

• etc



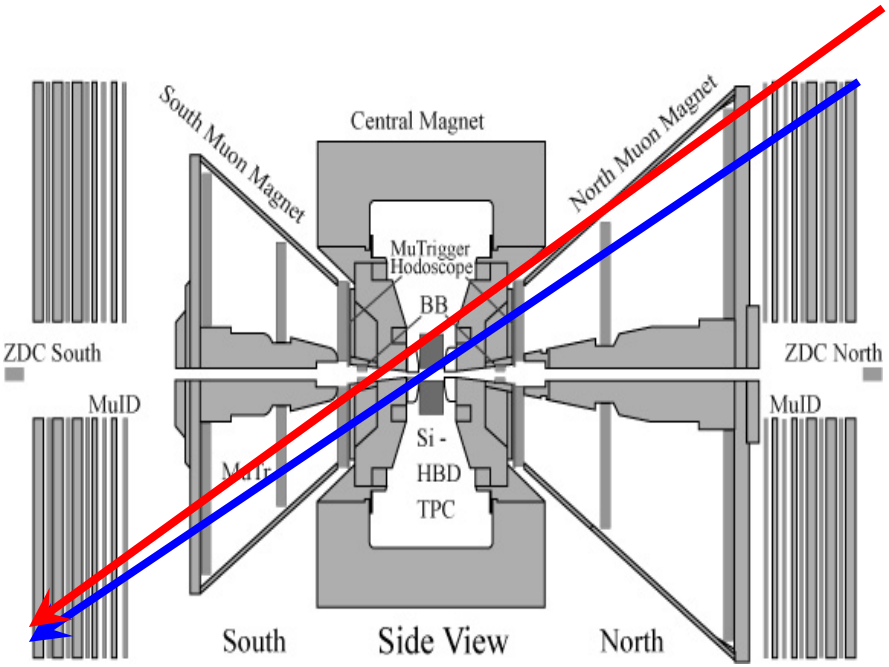
(plot from Tom Throwe)

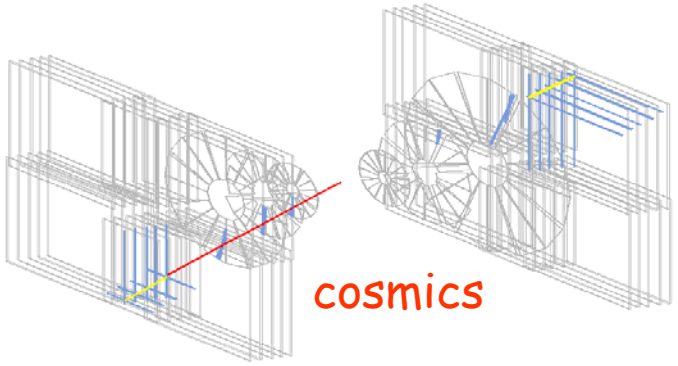
PHENIX Shakedown/Cosmic Ray Running (Jan & Feb)

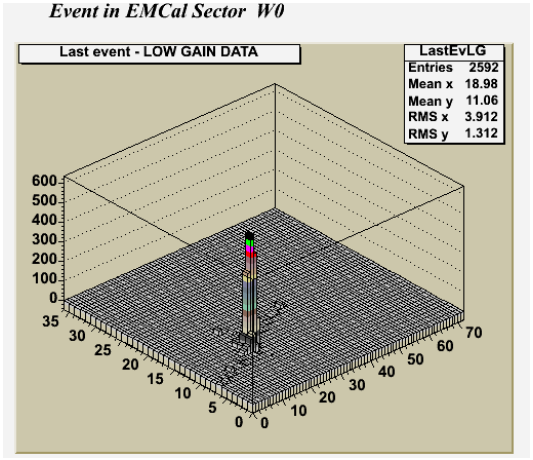
Need Cosmic Ray background measurement for W physics

- Cosmic/W estimated to be 1/1 for p>=10 GeV, but estimate is unreliable – need measurement!

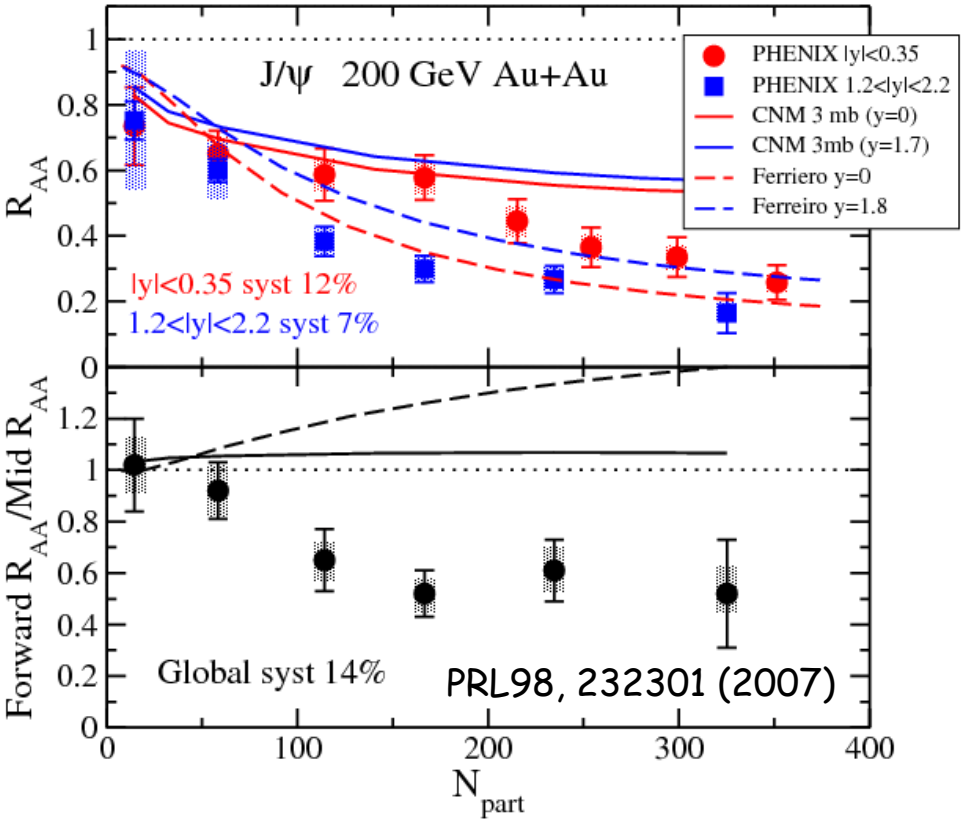
Also Cosmic ray in EMCal looks much like high-p_T photon

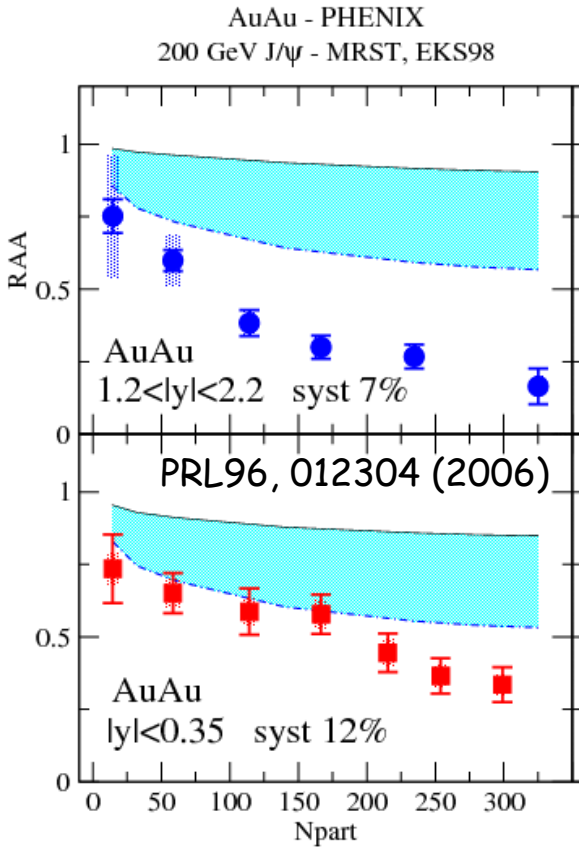






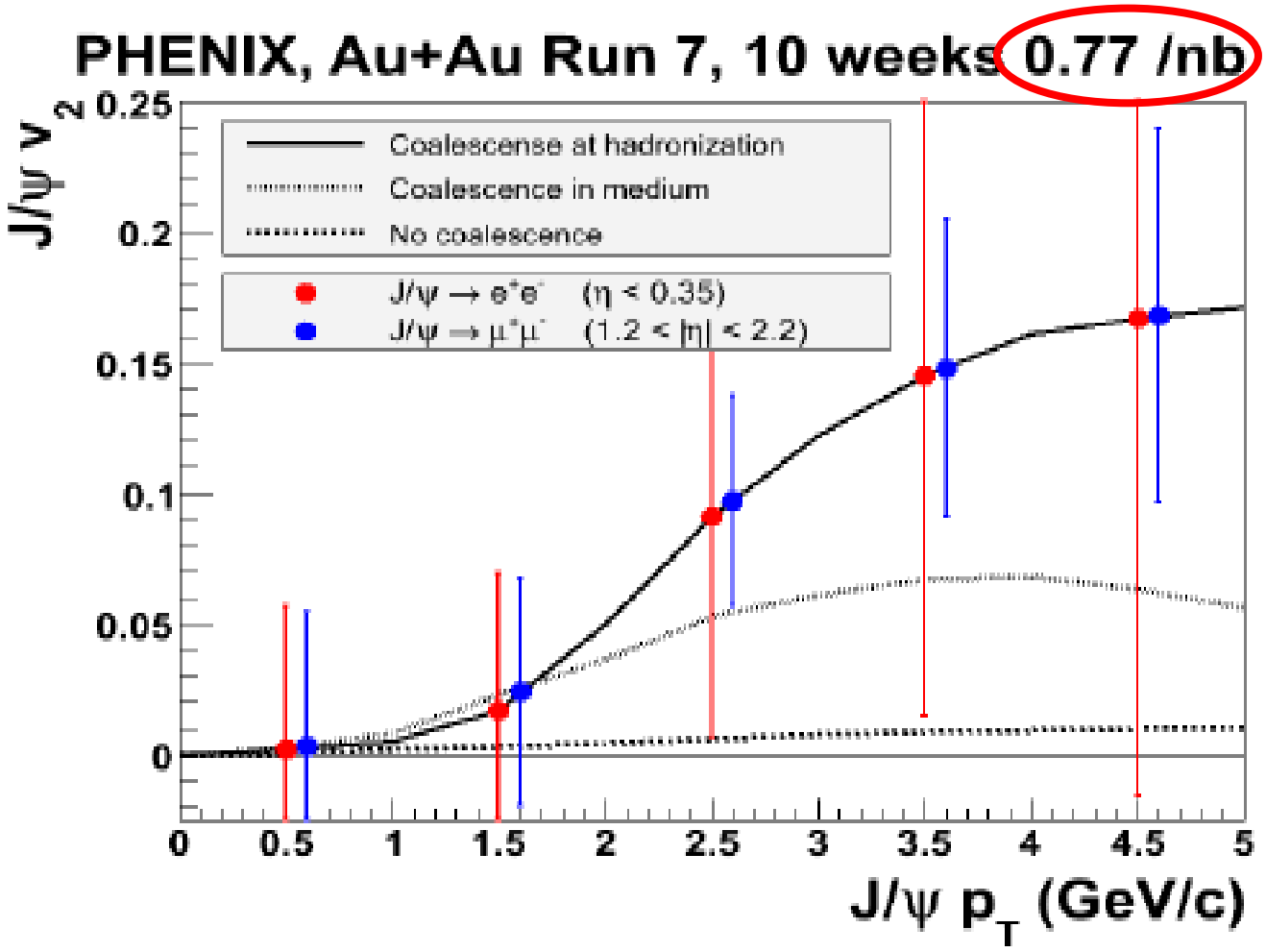
J/ψ's in AuAu Collisions at PHENIX



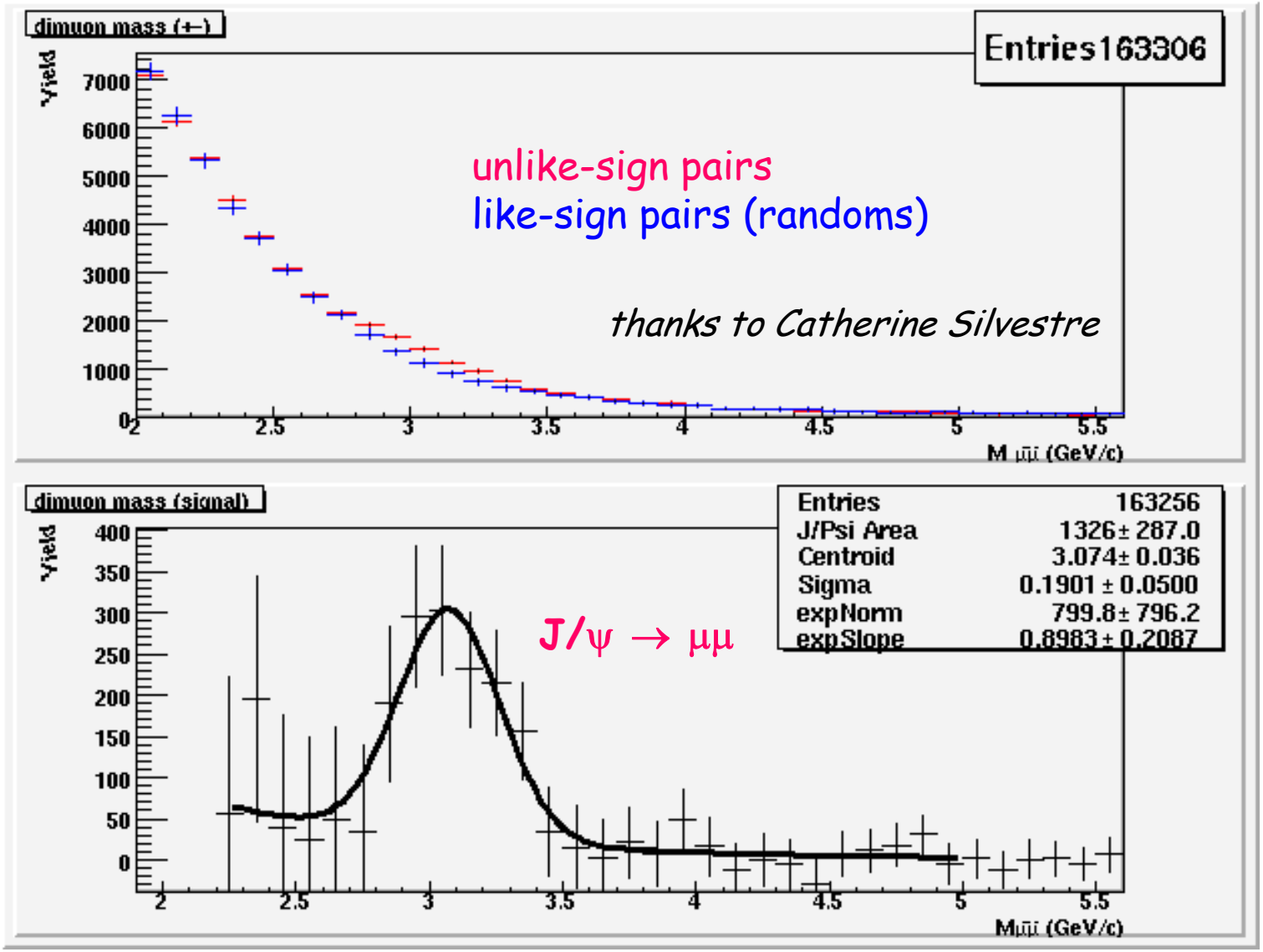


Statistical & systematic precision of new Run7 AuAu data will improve this picture – But will also benefit enormously from new dAu data that can constrain the cold nuclear matter baseline accurately

Expected Results for J/ψ flow from Run7



From Tony Frawley, heavy PWG, Jan 4th



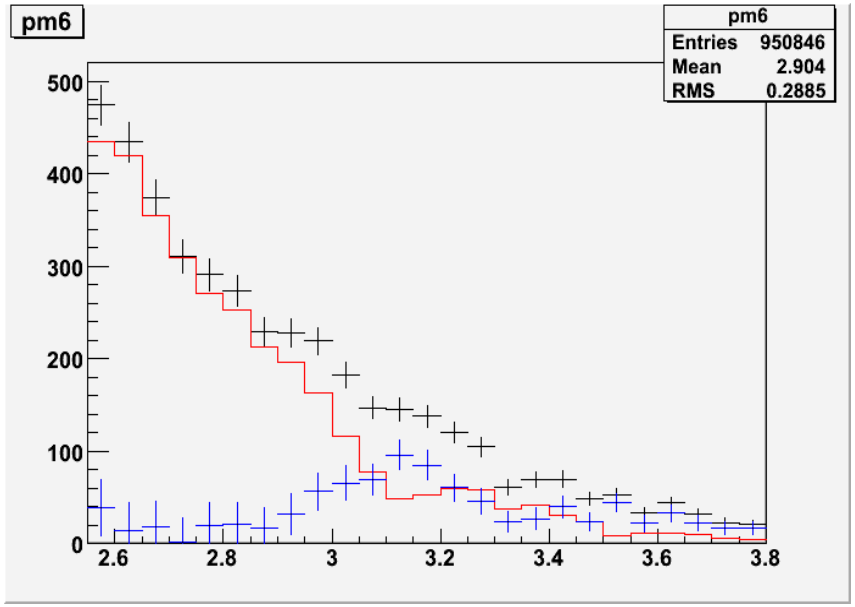
for ~8% of present Run7 integrated luminosity
(~16,000 J/ψ → μμ for present luminosity sum)

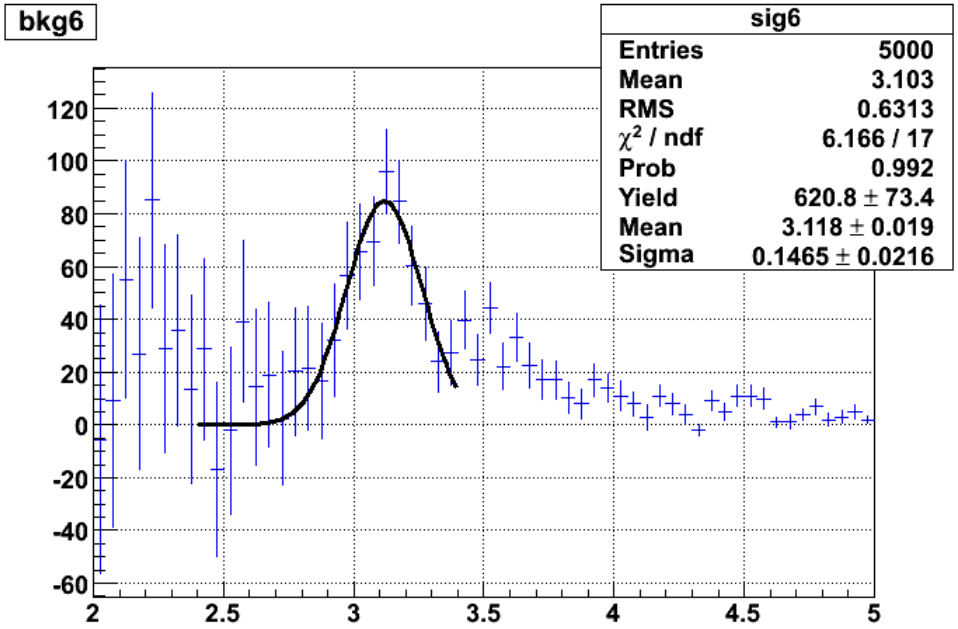
$J/\psi \rightarrow ee$

for roughly 60 μb^{-1}

scales to 5,000 or more J/ψ for present luminosity

thanks to Ermias Atomssa

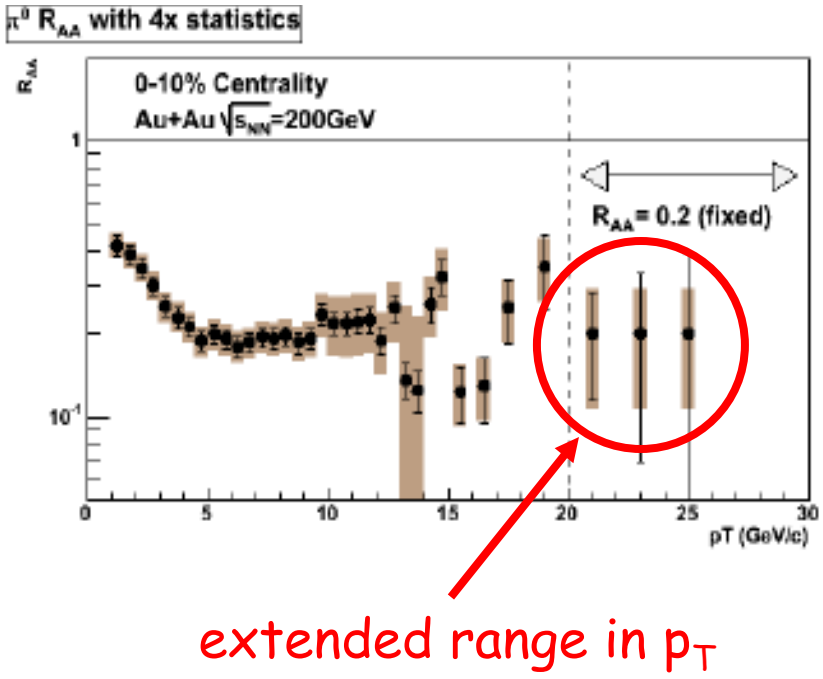




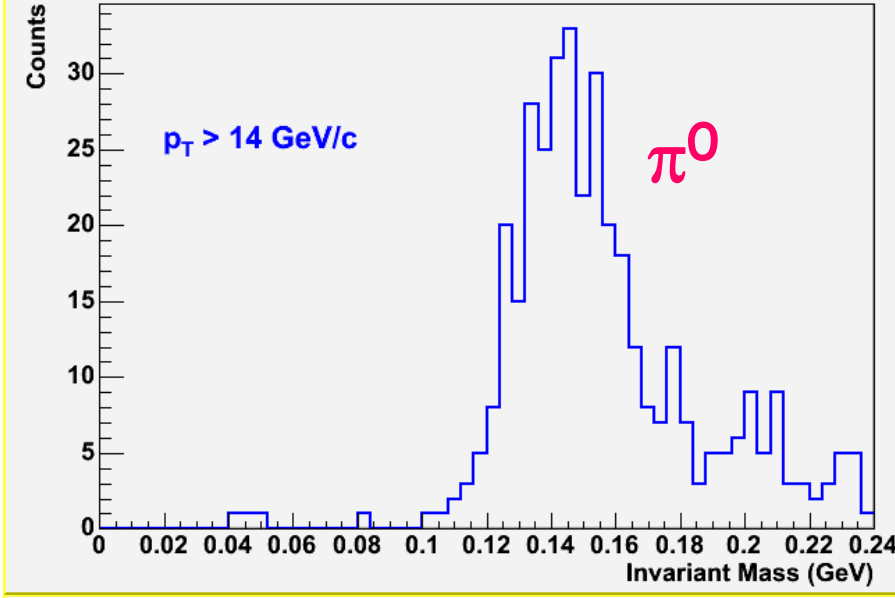
π^0's & η's

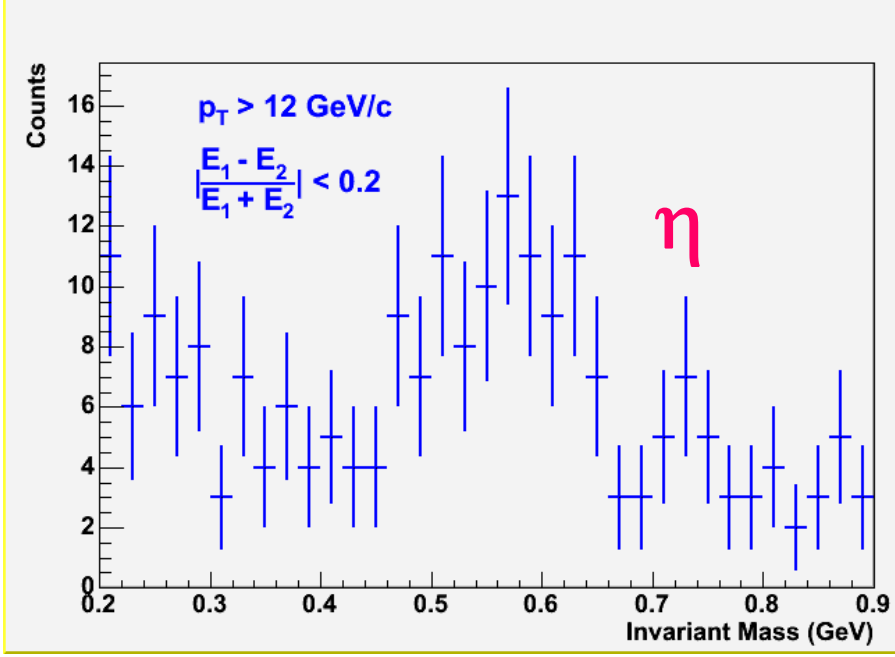
thanks to Justin Franz

from about 16% of present data



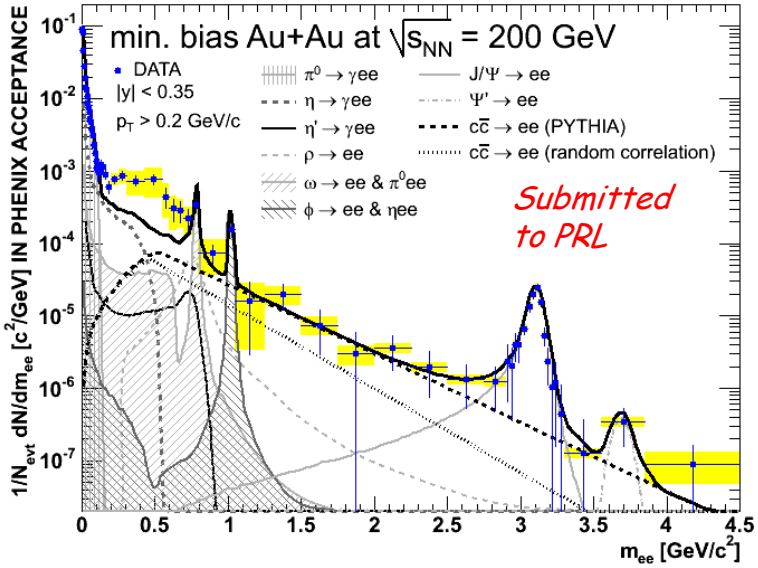
extended range in p_T

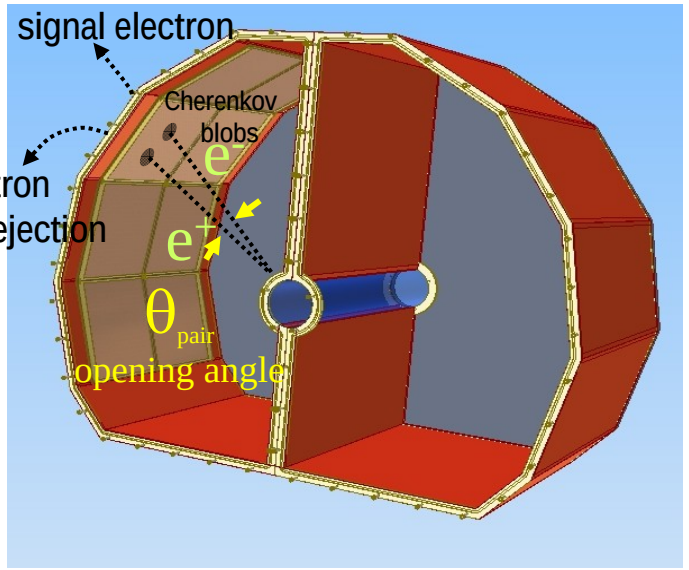




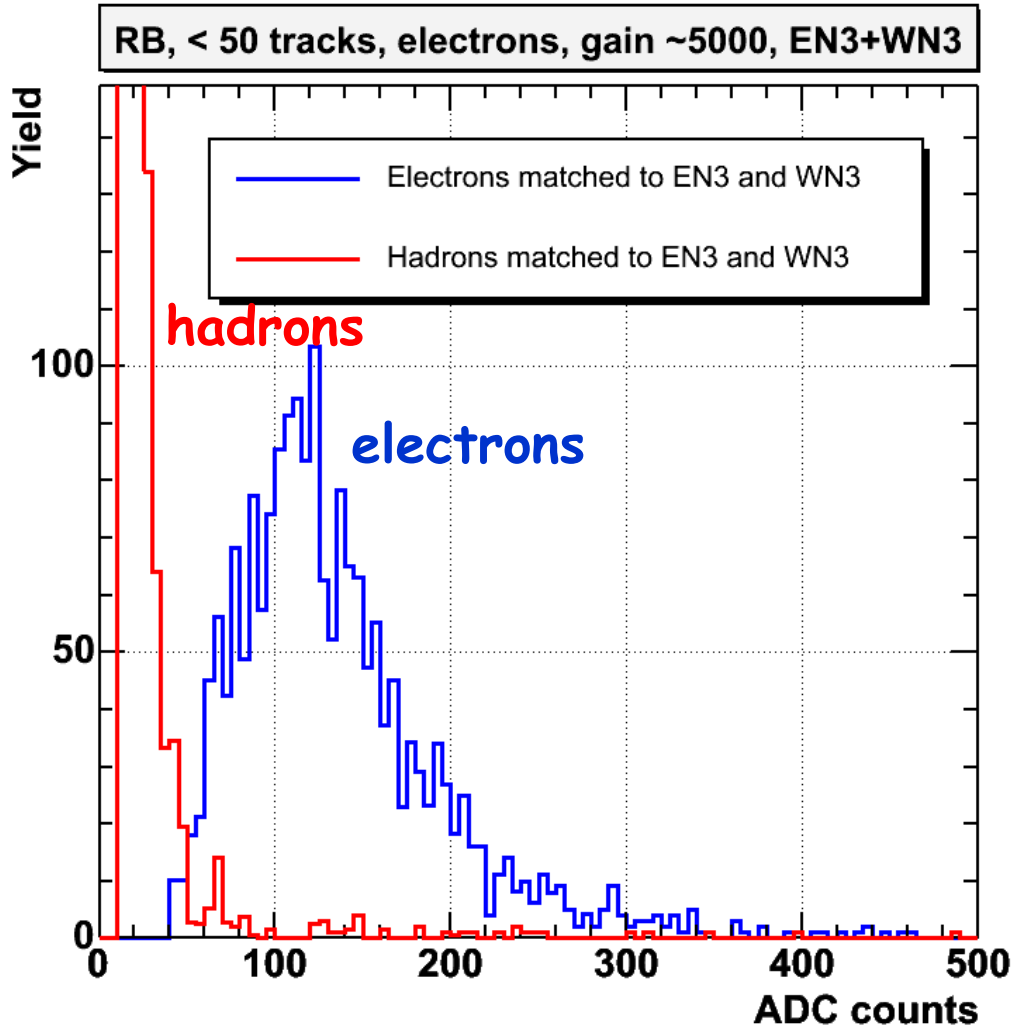
Hadron Blind Detector (HBD)

- A "hadron-blind" detector to detect and track electrons near the vertex."
- Dalitz rejection via opening angle
  - Identify electrons in field free region
  - Veto signal electrons with partner
- HBD: a novel detector concept:
  - windowless CF_4 Cherenkov detector
  - 50 cm radiator length
  - CsI reflective photocathode
  - Triple GEM with pad readout
- *The HBD will improve our S/B by a factor of ~100*



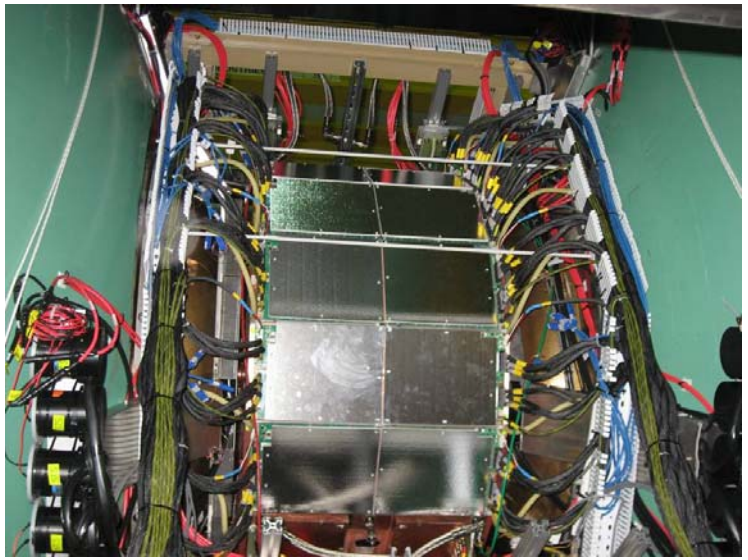


Hadron Blind Detector (HBD)



West side of HBD taken out Apr 25th for repairs

- HV trips with large stored energy damaged detector
- Now being refurbished with new GEM's & fixed HV
- ½ of the East side of HBD still in



Concluding Remarks

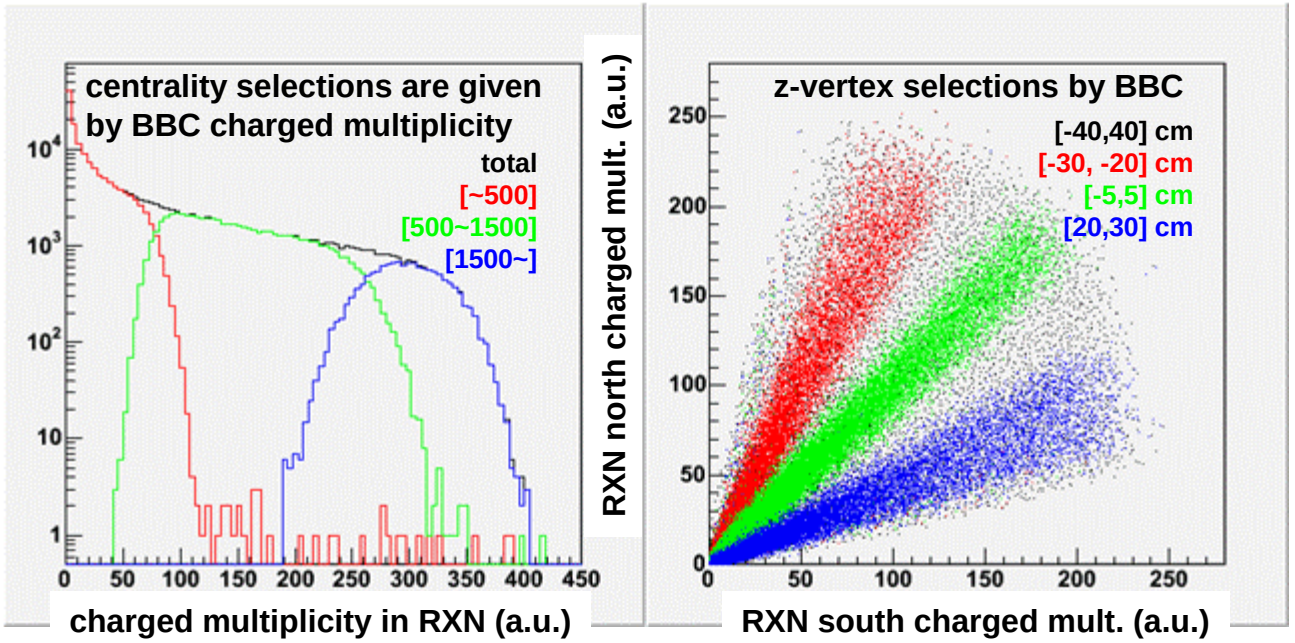
- Near 3 times Run4 luminosity (~750μb/241μb) PLUS new capabilities from new detectors – major advances in our physics should result
- Analysis in progress already thanks to level-2 filtering & mature analysis model
- HBD a very state-of-the-art detector, but lessons learned in Run7 should allow full operation in Run8 & beyond
- Excellent stores when they could be delivered, but too many breakdowns
  - Stochastic cooling - a step towards the future
  - Low energy (9.2 GeV) running feasible
- Thanks to our CA-D colleagues for all their unending work to keep us & the machine working!
- And of course to all my colleagues on PHENIX who were the ones who really made things work at the counting house

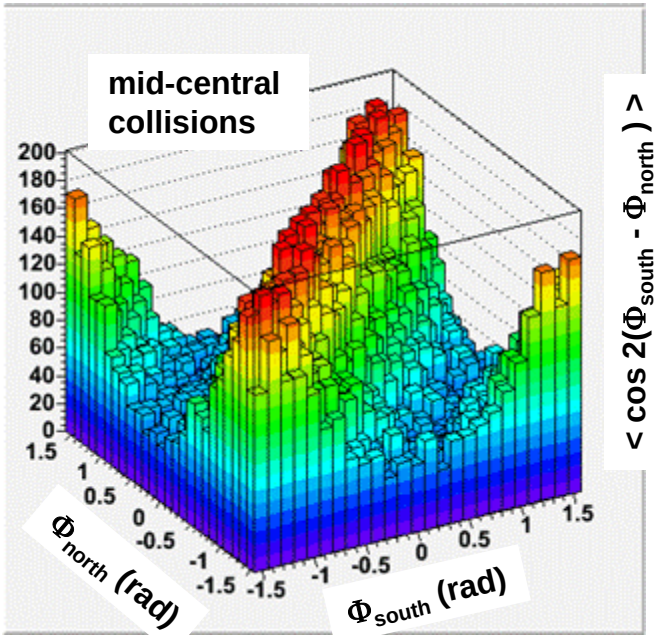
Backup

PHENIX Reaction Plane Detector (RXNP)

200GeV Au+Au collisions

RUN7 - 2007/Mar

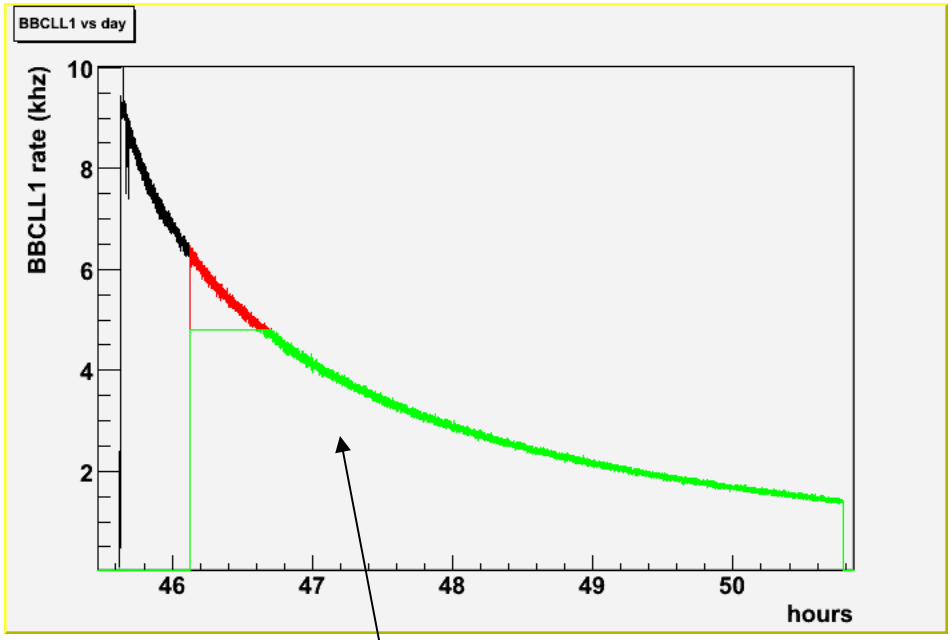


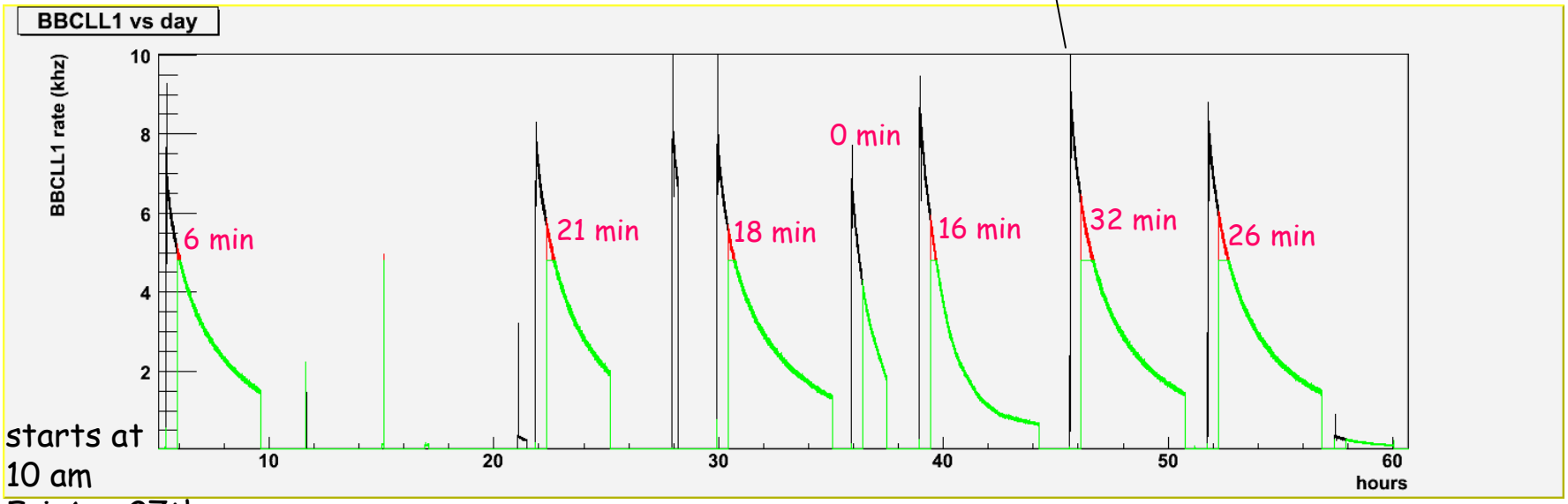


Luminosity fraction captured by PHENIX DAQ saturation in red

Fraction of luminosity for late April stores (at bottom)
97.8% for 4.8 khz DAQ rate

- for ½ hr turn-on time





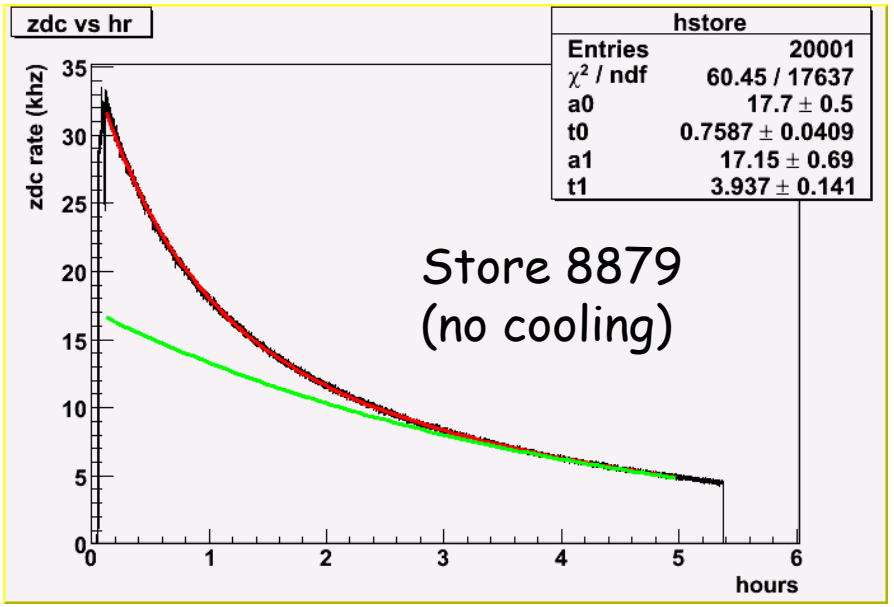
starts at 10 am Fri Apr 27th

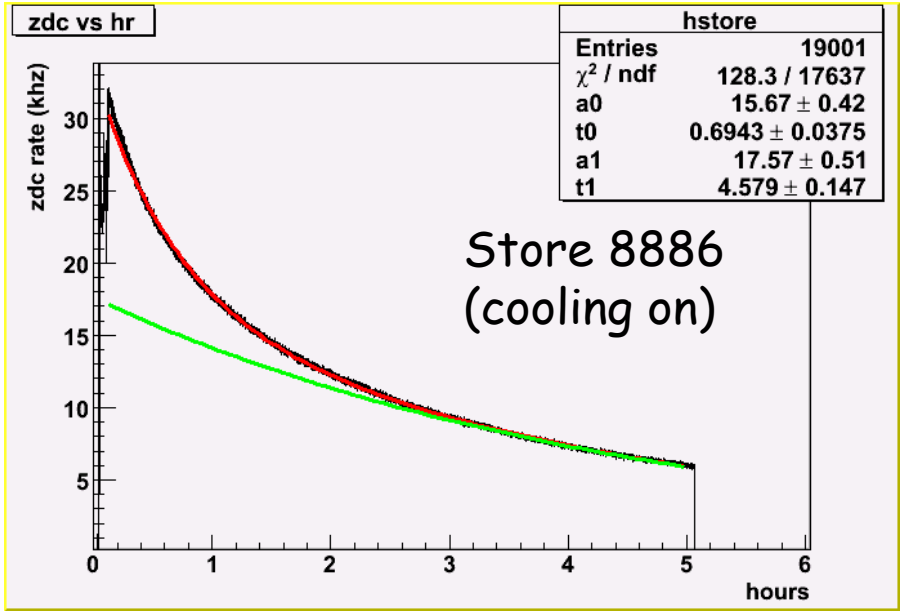
Improvement in integrated luminosity for PHENIX with Stochastic Cooling (SC)

date	time	store	cooled	μb^{-1}/hr	Zdc (pk)	FM ($x10^{-3}$)
5/15	2:10	8776	no	0.9804	34.97	28.04
5/30	2:10	8875	no	0.8789	32.07	27.41
5/30	23:50	8879	no	0.9746	34.85	27.97
5/19	14:47	8805	yes	1.1524	35.19	32.75
5/25	16:30	8849	yes	0.9874	30.34	32.54
6/1	8:00	8886	yes	1.0530	33.24	31.68

Average Improvement with SC:

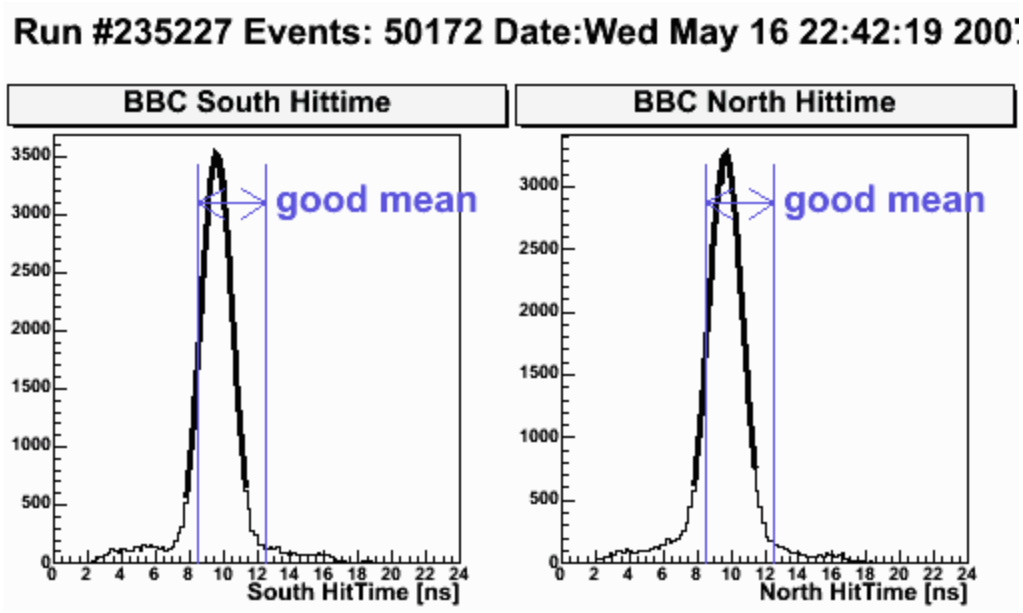
$$\frac{32.32 \pm 0.57}{27.81 \pm 0.35} = 1.16 \pm 0.03$$

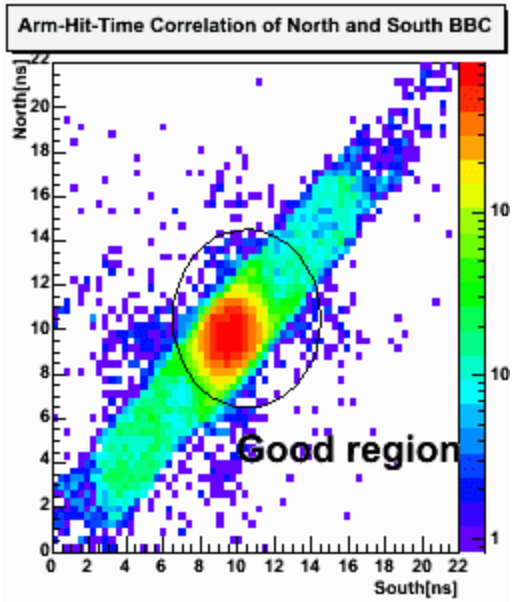




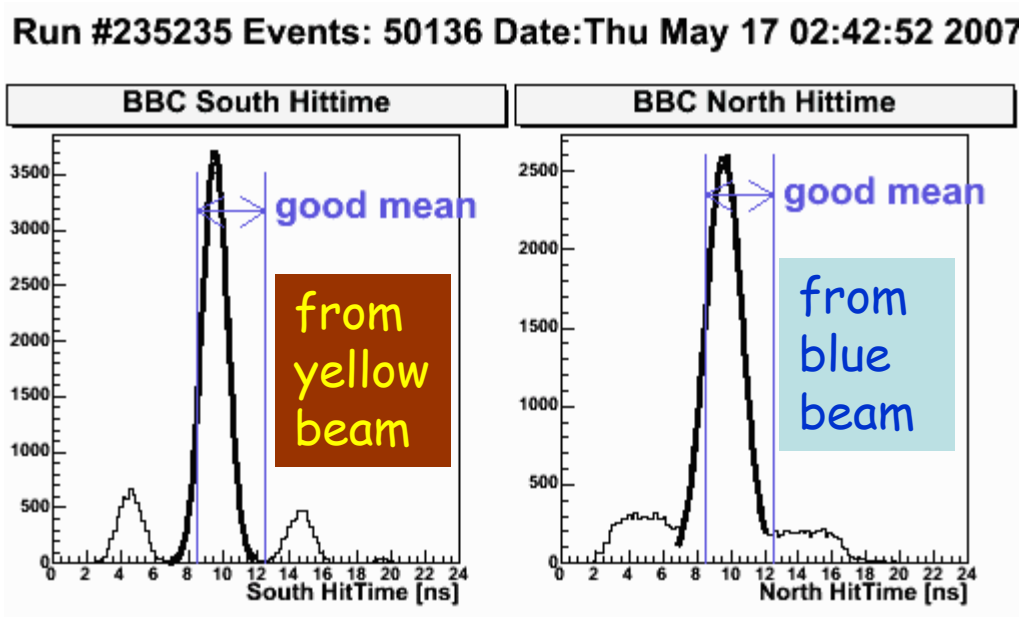
Effects of Stochastic Cooling at PHENIX

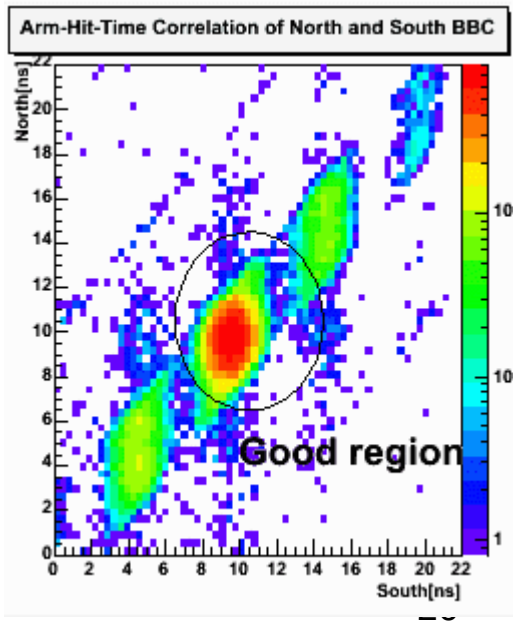
beginning of store



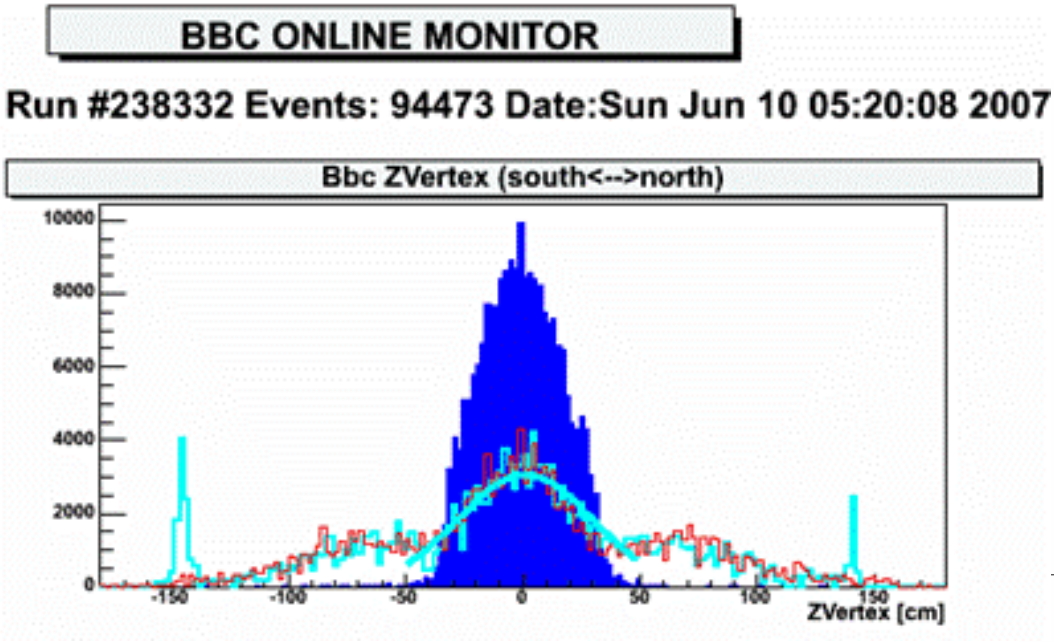


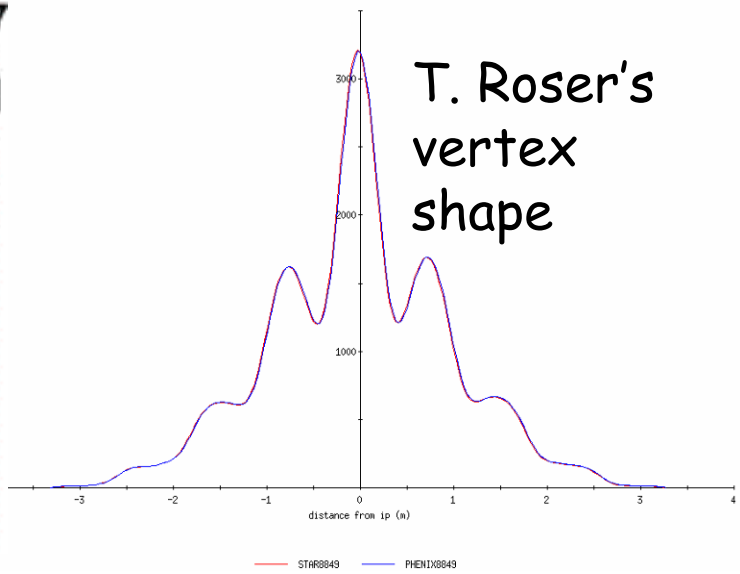
end of store





Differentiation of vertex into distinct peaks due to Stochastic Cooling

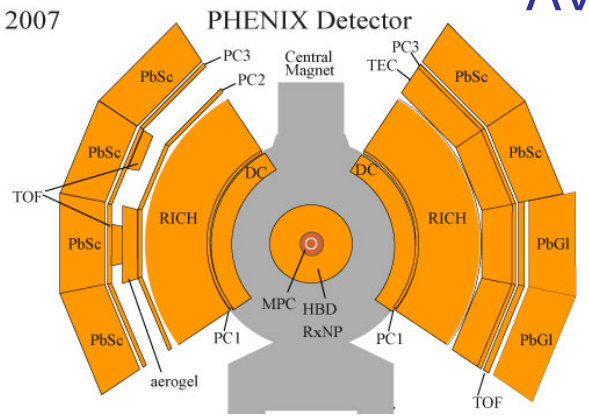




ZDC vertex (ZDC Wide)
BBC vertex (BBC no vertex cut)
BBC vertex (BBC ±30 cm vertex cut)

Vanderbilt Farm
1600 CPUs, 80 TBytes disk

PHENIX



45TB and 200 CPUs
Available for Run7 Reconstruction

Reconstruction
200 jobs/cycle
PRDFs → nanoDSTs
18 hours/job

RCF
RHIC computing facility

1

PRDFs
Raw data files
GridFTP to VU
30 MBytes/sec

FDT
45
MB/s

2

770 GBytes
per cycle

3

FDT
45
MB/s

dicated GridFTP Serv
Firebird
4.4TB of buffer disk space

4

nanoDSTs
Reco output to RCF
GridFTP 23 MB/sec

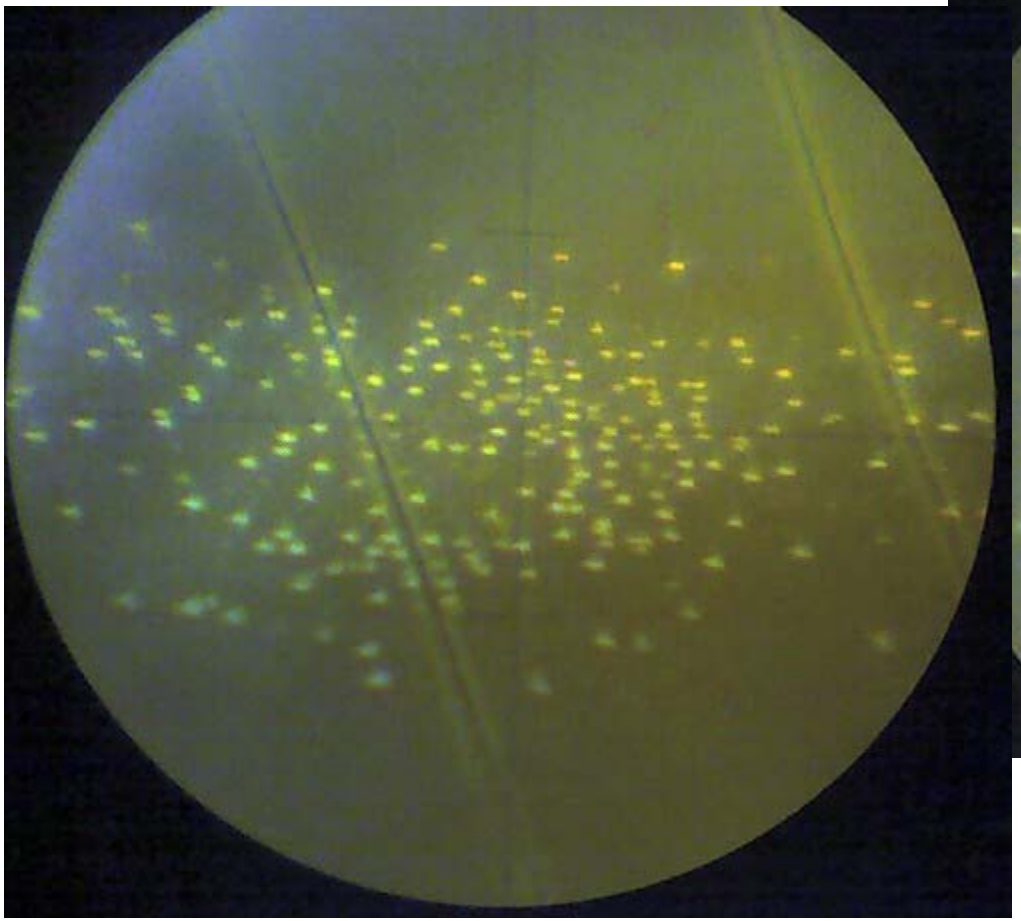
HBD Status

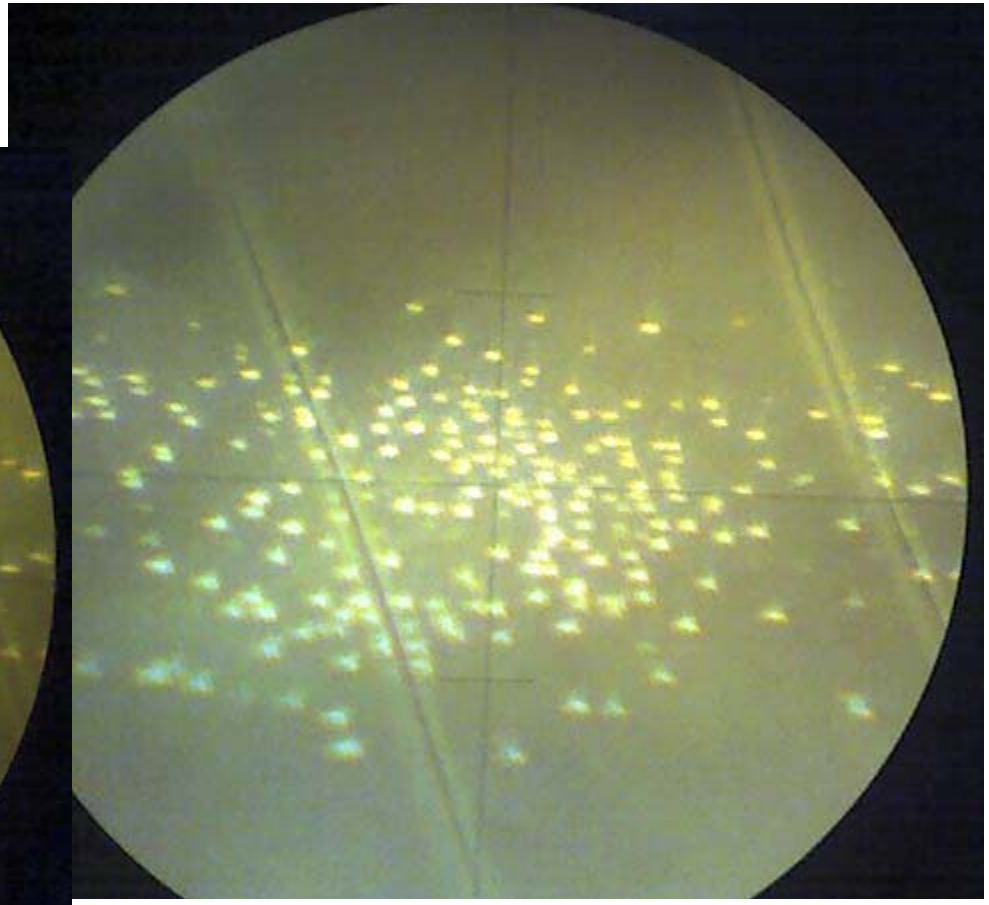
- We believe we have determined the main cause of the sparking problems with the both detectors:
  - Normal GEM spark would cause Lecroy HV to trip
  - Mesh also trips leaving large stored energy on filter capacitor
  - As GEM voltage goes to zero, large DV develops across gap between top GEM and mesh, ultimately resulting in a large spark
  - This spark induces sparks in other GEMs (massive trips) by propagation of scintillation light

  There is however a danger in the "One source of all troubles" theory and we are still looking for more possible causes of the problems we had during the run

from
T.Hemmick

Pock Marks





- Human eye could see the holes.
- Holes smaller than pock parks.
- Pocks almost certainly from mesh→GEM

from
T.Hemmick

Low Energy Running at PHENIX

- 9.19 GeV/nucleon
- PHENIX RXNP trigger
  - timed in at full energy
  - expect ~96% efficiency (compared to ~15% for BBC)
  - ZDC trigger should be very inefficient due to large Fermi motion wrt longitudinal momentum

- Wednesday afternoon could run our DAQ with the "blue low-energy clock"
- But Thursday morning, when beam was in the rings, we could not
- Presumably due to glitches in the clock (associated with other clock events that were not there on Wednesday??)